DOCUMENT RESUME

ED 237 071 IR 010 901

AUTHOR	Hudson, Heather; York, Lynn
TITLE	Information and the Economy: Policy Issues for Educators.
INSTITUTION	Southwest Educational Development Lab., Austin Tex.
SPONS AGENCY	National Inst. of Education (ED), Washington, DC.
PUB DATE	Jun 83
NOTE	66p.
PUB TYPE	Information Analyses (070)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	*Demography; *Economic Factors; Educational Opportunities; *Educational Technology; Federal Government; *Information Dissemination; Information Science; Library Education; Population Growth; Public Agencies; *Technological Advancement
IDENTIFIERS	*Information Sector; *Information Technology

ABSTRACT

This report provides an overview of the growth of the information sector in the United States and presents policy issues for educators which arise from trends in the economies and demography of six states: Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma, and Texas. Information work is classified as information creation, organization, handling, technology production, technology distribution, and maintenance. The major federal agencies involved in information policy are classified according to their role in information transmission; i.e., science, research, and technology; dissemination of information for education and training; information and the consumer; and international information policy and international trade. Recent federal legislation proposed to improve education is summarized, and the role of state governments is shown through examples of special task forces that have been established in the region to attract high technology industries. The discussion of policy issues includes an examination of the skills students will need in an information-based economy; applications of information technology (teleconferencing, videotext and teletext, video, and microcomputers) for classroom instruction, teacher training, educational administration, and home learning; strategies for coping with shortages of teachers and funds; and equal access to information technologies. Thirty references are listed. (Author/LMM)

INFORMATION and the ECONOMY:

Policy Issues for Educators

Dr. Heather Hudson
Associate Professor
and Lynn York
Department of Radio/TV/Film
College of Communication
University of Texas

SEDL
Southwest Educational Development Laboratory
Research Paper
June 1983

Dr. Hudson directed the research of this document. She was assisted by Lynn York.

Dr. Heather E. Hudson is an Associate Professor in the Department of Radio-Television-Film at the University of Texas at Austin. Her particular areas of interest are the applications of new communications technologies, telecommunications policy, and the role of telecommunications in rural development.

Lynn York is a graduate student in the MA/MBA program in Communications at the University of Texas at Austin. She worked for Prentice Hall's textbook division after completing her undergraduate education.

SEDL

The Southwest Educational Development Laboratory (SEDL) is one of a network of regional educational laboratories and university-based research and development centers operating to improve educational practice through research, development, technical assistance, and dissemination activities.

Dr. Preston C. Kronkosky
Executive Director

RPSP

- Providing assistance in planning and problem-solving since 1979, THE REGIONAL PLANNING & SERVICE PROJECT (RPSP) serves the Chief State School Officers or their designees in Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma, and Texas.

- RPSP provides information for policy analysis, planning, and decision-making, and provides access to experts in policy and planning areas. It is a client-responsive project which seeks to solve problems and address issues cooperatively.

- RPSP focuses on such issues as consolidation of programs, preventive law, accountability and competency, legislative relations, public confidence in education, staff development of school administrators, and forecasting educational developments.

- RPSP is a project of the Division of Educational Information Services of the Southwest Educational Development Laboratory and is funded by the National Institute of Education.

Dr. Martha L. Smith
Division Director

Ms. Cynthia Y. Levinson
Project Administrator

Dr. Patricia C. Duttweiler
Policy Analyst

Ms. Barbara A. Lecroy
Administrative Assistant

"In preindustrial societies—still the condition of most of the world today—the labor force is engaged overwhelmingly in the extractive industries: mining, fishing, forestry, agriculture. Life is primarily a game against nature.... Industrial societies—principally those around the North Atlantic littoral plus the Soviet Union and Japan—are goods-producing societies. Life is a game against fabricated nature. The world has become technical and rationalized. The machine predominates, and the rhythms of life are mechanically paced.... A postindustrial society is based on services. What counts is not raw muscle power, or energy, but information." Daniel Bell, The Coming of Post-Industrial Society, 1973.

TABLE OF CONTENTS

	Executive Summary	i
I.	Introduction	1
	A. The Purpose of This Report	1
	B. Toward an Information Society	1
	C. Examples of the Role of Information in National and Regional Industries	3
II.	The Information Sector in the United States and the Six-State Region	6
	A. Measuring the Information Sector	6
	B. What is Information Work?	15
	C. Growth of Information Sector Occupations	16
III.	Changes in the Demography of the Six States	21
IV.	Information Policy at the Federal and State Levels	25
	A. The Federal Role in Information	25
	B. State and Local Agencies	31
V.	Educational Policy Issues	35
	A. What Knowledge and Skills will Students Need?	35
	B. Applications of Information Technology for Education	37
	B. Coping with Shortages of Teachers and Funding	42
	C. Matching Technologies and Needs	45
	D. Issues of Equity	47
VI.	Conclusions	49
	References	53

Executive Summary

The purpose of this report is to provide an overview of the growth of the information sector in the United States, to examine trends in the economies and demography of six states, and to present policy issues for educators which arise from these developments. The six states included in the study are Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma, and Texas.

The report begins with an examination of the information sector in the national and regional economies. Using categories developed by Porat (1977), the growth of businesses in the primary information sector is presented for the U.S. and the six-state region, showing that there was substantial growth in the number of these businesses, and that this growth was slightly greater in the region than in the nation as a whole. Information work is classified into information creation, information organization, information handling, information technology production, and information technology distribution and maintenance. Projections indicate that while there will be a large percentage increase in highly skilled technical jobs in this decade, the absolute number of such new jobs will be relatively small. The greatest number of new jobs is expected to be in low skilled service occupations. However, more and more existing jobs will require use of information technology.

Major demographic characteristics of the six states are presented. While it is difficult to generalize about the region, most states are characterized by a growing minority population. In four states, minorities constitute more than 35% of the school age population. All of the states have lower median incomes than the national average, and higher percentages of individuals and families below the poverty level. Minorities, particularly blacks, lag far behind whites in income levels and educational attainment. These factors are likely to compound the problems facing educators planning for an information-based economy.

The major federal agencies involved in information policy are classified according to their role in the transmission of information; science, research, and technology; dissemination of information, education, training; information and the consumer; and international information policy and international trade. Recent federal legislation proposed to improve education, particularly in the sciences and information technology training, is summarized. The role of state governments is shown through examples of special task forces which have been established in the region to attract high technology industries. Cities in the region have also been active in attracting such industries.

The discussion of policy issues begins with an examination of the skills students will need in an information-based economy, and emphasizes both the skills needed to use information technology and a rigorous "traditional" education to provide the knowledge students will need in an increasingly complex society. Examples of applications of information technology for classroom instruction, teacher training, educational administration, and home learning are cited, including uses of teleconferencing, videotext and teletext, other video technologies, and microcomputers. Strategies for coping with shortages of teachers and funds are presented, including collaborative activities with industry and special incentives for technical teachers. It will be important to match the technology with the needs of the students, and to ensure that there is adequate and appropriate software for the information technologies in the classroom, so that some of the previous failures of educational technology are not repeated. Finally, the report raises the issue of equity, stressing disparities between schools, and also the role of the schools in providing access to information technologies to counter inequitable opportunities for students to use these technologies at home. Issues of equity are considered particularly significant in the region because of the high proportion of minority and rural students in the school systems.

I. Introduction

A. The Purpose of this Report

This report was commissioned by the Southwest Educational Development Laboratory (SEDL) as a background issues paper for its conference on "Information and the Economy: Policy Issues for Educators." The purpose of the report is to provide an overview of the growth of the information sector in the United States, to examine trends in the economies and demography of the region, and to present policy issues for educators which arise from these developments.

The region examined in the report includes the states of Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma, and Texas. Educational considerations focus primarily on the school years, i.e. kindergarten through the 12th grade, although implications for out-of-school educational activities and post-school education (college, vocational training, continuing education) are also considered. The report attempts, insofar as possible, to draw on data and examples from the six state region. However, lack of accessible data and adequate time have limited our ability to treat some of the issues in the depth that they may deserve.

B. Toward an Information Society

We are living in an era of transition. While a century ago the United States was beginning to shift from a primarily extractive economy (i.e. based on agriculture, forestry, and mining) to an industrialized economy in which a majority of the economic activity consisted in the transformation of raw materials into processed and manufactured goods, today we are witnessing a shift from an industrially-dominated economy to an information-based economy.

Several factors account for this shift. Perhaps the most visible are the technological advances which have given us greater power over information, which may be defined as organized symbols. This power manifests itself in two ways -- in our ability to manipulate information much more rapidly (e.g. using microprocessors in calculating, storing, sorting, and retrieving information) and our ability to transmit information -- using telecommunications. The key variables in this change are volume and speed -- while we were able to manipulate information manually before, and to transport it physically, we can now manipulate and transmit more and more information in less and less time.

The activity of "producing, processing, and distributing information" (Porat, 1977) has become complex as the technologies of separate media converge -- linking cable systems to computer systems, connecting telephones to data banks. A simple telephone call may travel through fiber optics, coaxial cable, microwave signals, or satellite transponder links. A family television set may serve as a receiver of broadcast or cable programs, a terminal display for a computer, or a screen for video games.

These converging technologies may be grouped into the following categories:

- -- information processing/manipulating technologies: e.g. computers; calculators; other equipment using microprocessors;
- -- information storage technologies: e.g. magnetic tape for audio, video, and data; videodiscs; floppy and hard computer disks;
- -- information transmission technologies: e.g. satellites; coaxial cable; optical fibers; over-the-air broadcasting.

These converging technologies are likely to have major impacts on the work we do and how we do it, and on how we live. Two of the major implications of this merging of technologies are decentralization and interdependency. The ability to transmit information very rapidly and inexpensively has enabled organizations to decentralize their operations throughout the nation or around the world, and some workers to work from their homes rather than commuting. Information can be received in the home from an expanding number of sources -- including broadcast and cable networks, data banks, videotext or teletext services, and electronic stored on tape or disc. Coupled with this decentralization of sources and inputs is a growing interdependency as we become more specialized and more dependent on other specialists, or specialized units.

It should be noted that despite the growth of information activities, our need for primary resources and manufactured goods has not decreased. Two factors account for the declining activities in these sectors. First, earlier advances in technology have increased productivity, enabling us to increase output of both agricultural products and manufactured goods using less human labor. Many applications of information technology including robotics, information processing, and teleconferencing may be seen as extensions of this trend toward increasing productivity through advances in technology. Secondly, much of the industrial activity we depend upon is now carried out overseas -- including not only the production of basics such as clothing, steel, automobiles, for example, but also the assembly of information tools -- calculators, home computers, audio and video equipment.

C. Examples of the Role of Information in National and Regional Industries

Many traditional information-based industries have expanded by taking advantage of new information technologies. In the publishing industry, newspaper, periodical, and even book publishers now use electronic data transfer to speed publication and delivery of their products. National newspapers such as The Wall Street Journal and USA Today assemble most of their copy at a central location and then transfer it to printing locations around the country. In this way, the consumer can receive a national newspaper as quickly as a hometown edition, and the national publisher reduces the cost of transporting the final product. Book editors use data transfer to link a publishing house with its authors. This technology allows rapid exchange between editor and author and avoids time-consuming mailing and typesetting processes.

The banking industry, with its dependence on accounting and market information, has also undergone a transformation because of new information technologies. The large data processing requirements of the industry caused the banks to use computers as soon as reliable models were available. An increasingly competitive market forced many banks to concentrate on customer service, leading the institutions toward computerized transaction services. In 1977, banks introduced automatic teller machines which could serve customers at many locations on a twenty-four hour basis. Other innovations led to the concept of home banking. With a bank's ability to centralize transactions, the pilot home banking projects were in the guise of telephone bill payment (TBP) services. Over 400 banking institutions now offer this service. (van der Velde, 1982) Several market tests for complete home banking services through the use of home computers or videotext services are now in place in Los Angeles, Minneapolis, Knoxville, and New York City. (Padilla, 1983)

Producers of information technology have also made large gains in recent years, particularly those producers that serve the home consumer.

Texas Instruments, a Dallas-based company that makes pocket calculators among many other electronic goods, gained an average of 24 percent per year in total revenue in the period of 1975 through 1980. In the same period, the Tandy Corporation, which operates the Radio Shack stores, gained an average of 21 percent in revenue per year.

The technological innovations in information and communication have also reached industries formerly not considered information-based businesses. Value-added services involving specialized data bases or computer programs are entrenched in many industries. The Lexis legal data base and the Dow Jones business data base offer the legal and business communities timely, detailed information with easy access procedures. Executives with little computer experience now use many "user friendly" computer program packages such as Visicalc and the Interactive Financial Planning Service (IFPS) to make complex business decisions.

Two industries vital to the six-state region of Arkansas, Oklahoma, Louisiana, Mississippi, New Mexico, and Texas -- agriculture and oil and gas -- also integrate new information technologies into their businesses. Home computers have made the purchase of data bases inexpensive for farmers, who use their computers for tasks such as estimating the expected return from marketing steers, maintaining feeding and breeding data, determining least cost rations for animal feeding. In Nebraska, Michigan, and Virginia, farmers with complex analysis needs can subscribe to remote terminal services that link them with main frame computers in nearby universities. (Foster, 1982)

DALSAT, a Dallas-based satellite equipment company, designed and installed a satellite network for Iowa Beef Processors which links their buyers in the field throughout the midwest to their home office. One innovative project in communications for agriculture was the "Green Thumb Project" of Kentucky, in which a videotext service was offered to farmers. Videotext is a new technology that allows specially-equipped television sets to receive signals from broadcast or cable delivery. In this project, a farmer could request data through a telephone link with computer data banks, and the information, in written or graphic form, would appear on his television. In Project Green Thumb, farmers had access to information about the weather, market prices, agricultural production, county information, youth-oriented information, home economics, and community information. (Warner and Greenfield, 1981) A similar project called Grass roots operates in Manitoba.

A Houston-based company, Drilling Information Service Company (DISC) has recently developed a new drilling supervisory system for the oil and gas industry using satellite communication. This system allows a drilling supervisor in a central office access to data about an oil drilling process as quickly as personnel on the site. Through the use of a terminal, voice, data, and facsimile transmission via satellite, a supervisor can communicate to any drilling site on land or offshore, regardless of the weather or distance. (Communication News, 1982)

II. The Information Sector in the United States and the Six-State Region

A. Measuring the Information Sector

As the activity of producing and distributing information has become a major force in the economy, several economists have attempted to define and quantify the information sector. This task has been difficult for two reasons. First, the broad nature of information and communication makes a specific definition hard to formulate. Second, industries engaged in an information activity belong to a variety of the traditional sectors of the economy. Computer producers and book binders belong in the industrial sector, while advertising agencies, schools and libraries are part of the service sector, yet each of these industries contribute to the information sector as well.

In 1977, Marc Porat made a detailed study of the economy for the Department of Commerce, attempting to list and classify the industries that compose the information sector. Porat defines "information industries" as businesses that offer goods or services that "intrinsically convey information" or are "directly useful in producing, processing, or distributing information." Porat identifies primary and seco. y information sectors. The primary sector includes all industries that produce information machines or market information services as a commodity. It includes, for example, computer manufacturing and services, telecommunications, printing, media, advertising, accounting and education. Table 1 shows the industries that Porat considered part of the primary information sector. The secondary sector consists of all the information services produced for internal consumption by government and non-informational firms. These services would include management, financial control, scheduling, reservations, inventory control, research, marketing, etc. Bell (1981) characterizes these as the public and private bureaucracies. Their contribution is more difficult to determine, because the output is not information products but other goods and services.

By 1974, information activities contributed approximately 54% to the national income (GNP) or which 29% of the national income could be attributed to the primary information sector, and 25% to the secondary information sector (Bell in Forrester, 1981).

Table 1: Detailed Typology of the Primary Information Sector

MARKETS FOR INFORMATION

KNOWLEDGE PRODUCTION AND INVENTIVE INDUSTRIES

R&D and Inventive Industries

(7391) Commercial Research and Development Laboratories
(7397) Commercial Testing Laboratories
(8921) Nonprofit Education and Scientific Research Agencies

Private Information Services

(6281) Services Allied with the Exchange of Securities or Commodities
(6611) Combinations of Real Estate, Insurance, Loans, Law Offices
(7392) Business, Management, Administrative, and Consulting Services
(8111) Legal Services
(8911) Engineering and Architectural Services
(8931) Accounting, Auditing, and Bookkeeping Services
(8999) Services, Not Elsewhere Classified

INFORMATION DISTRIBUTION AND COMMUNICATION INDUSTRIES

Education

(8211) Elementary and Secondary Schools
(8221) Colleges, Universities, and Professional Schools
(8222) Junior Colleges and Technical Institutes
(8241) Correspondence Schools
(8242) Vocational Schools, Except Vocational High Schools
(8299) Schools and Educational Services, Not Elsewhere Classified

Public Information Services

(8231) Libraries and Information Centers

Regulated Communication Media

(4832) Radio Broadcasting
(4833) Television Broadcasting

Unregulated Communication Media

(2711) Newspapers: Publishing, Publishing and Printing
(2721) Periodicals: Publishing, Publishing and Printing
(2731) Books: Publishing, Publishing and Printing
(2741) Miscellaneous Publishing
(7351) News Syndicates
(7813) Motion Picture Production, Except for Television
(7814) Motion Picture and Tape Production for Television
(7815) Production of Still and Slide Films
(7816) Motion Picture Film Exchange
(7817) Film or Tape Distribution for Television
(7821) Motion Picture Service Industries
(7922) Theatrical Producers (Except Motion Picture) and Miscellaneous Theatrical Services

INFORMATION IN MARKETS

SEARCH AND COORDINATION INDUSTRIES

Search and Non-Speculative Brokerage Industries

(6052) Foreign Exchange Establishments
(6053) Check Cashing Agencies and Currency Exchanges
(6055) Clearing House Associations
(6161) Loan Correspondents and Brokers
(6231) Security and Commodity Exchanges
(6411) Insurance Agents, Brokers, and Service
(6531) Agents, Brokers, and Managers
(6541) Title Abstract Companies
(7313) Radio, Television, and Publishers' Advertising Representatives
(7321) Consumer Credit Reporting Agencies, Mercantile Reporting Agencies, and Adjustments and Collection Agencies
(7361) Private Employment Agencies
(7398) Temporary Help Supply Services
(7818) Services Allied to Motion Picture Distribution

Advertising Industries

(3993) Signs and Advertising Displays
(7311) Advertising Agencies
(7312) Outdoor Advertising Services
(7319) Miscellaneous Advertising
(7331) Direct Mail Advertising Services

Non-Market Coordinating Institutions

(8611) Business Associations
(8621) Professional Membership Organizations
(8631) Labor Unions and Similar Labor Organizations
(8651) Political Organizations

RISK MANAGEMENT INDUSTRIES

Insurance Industries (Components Only)

(63) Life, Accident, Fire and Casualty
(636) Title Insurance

Finance Industries (Components Only)

(60) Commercial, Savings Banks & Related Institutions
(61) Credit Institutions

Speculative Brokers (Components Only)

(62) Security Brokers, Commodity Contractors
(63) Patent Owners and Lessors

Table 1 continued:

INFORMATION INFRASTRUCTURE

INFORMATION PROCESSING AND TRANSMISSION SERVICES

Non-Electronic Based Processing

Fixed Costs:

(2753) Engraving and Plate Printing
(2791) Typesetting
(2793) Photoengraving
(2794) Electrotyping and Stereotyping

Variable Costs:

(2732) Book Printing
(2751) Commercial Printing, Except Lithographic
(2752) Commercial Printing, Lithographic
(2789) Bookbinding and Related Work
(7221) Photographic Studios, Including Commercial Photography
(7332) Blueprinting and Photocopying Services
(7339) Stenographic Services; and Duplicating Services, Not Elsewhere Classified
(7395) Photofinishing Laboratories

Electronic Based Processing

(7392) Pure Data Processing Services

Telecommunication Infrastructure

(4811) Telephone Communication (Wire or Radio)
(4821) Telegraph Communication (Wire or Radio)
(4899) Communication Services, Not Elsewhere Classified

INFORMATION GOODS MANUFACTURING INDUSTRIES

Non-Electronic Consumption or Intermediate Goods

(2621) Paper Mills, Except Building Paper Mills
(2642) Envelopes
(2761) Manifold Business Forms
(2782) Blankbooks, Loose Leaf Binders and Devices
(2893) Printing Ink
(2895) Carbon Black
(3861) Photographic Equipment and Supplies
(3951) Pens, Pen Points, Fountain Pens, Ball Point Pens, Mechanical Pencils and Parts
(3952) Lead Pencils, Crayons, and Artists' Materials
(3953) Marking Devices
(3955) Carbon Paper and Ink Ribbons

Non-Electronic Investment Goods

(3554) Paper Industries Machinery
(3555) Printing Trades Machinery and Equipment
(3574) Calculating and Accounting Machines, Except Electronic Computing Equipment
(3576) Scales and Balances, Except Laboratory
(3579) Office Machines, Not Elsewhere Classified
(3821) Mechanical Measuring and Controlling Instruments, Except Automatic Temperature Controls
(3822) Automatic Temperature Controls
(3821) Optical Instruments and Lenses

Electronic Consumption or Intermediate Goods

(3652) Phonograph Records
(3671) Radio and Television Receiving Type Electron Tubes, Except Cathode Ray
(3672) Cathode Ray Picture Tubes
(3673) Transmitting, Industrial and Special Purpose Electron Tubes
(3674) Semiconductors and Related Devices
(3679) Electronic Components and Accessories, Not Elsewhere Classified
(5065) Electronic Parts and Equipment

Electronic Investment Goods

(3573) Electronic Computing Equipment
(3611) Electric Measuring Instruments and Test Equipment
(3651) Radio and Television Receiving Sets, Except Communication Types
(3661) Telephone and Telegraph Apparatus
(3662) Radio and Television Transmitting, Signaling, and Detection Equipment and Apparatus
(3693) Radiographic X-ray, Fluoroscopic X-ray, Therapeutic X-ray, and other X-ray Apparatus and Tubes; Electromedical and Electrotherapeutic Apparatus
(3811) Engineering, Laboratory, and Scientific and Research Instruments and Associated Equipment

WHOLESALE AND RETAIL TRADE IN INFORMATION GOODS

Household Investment Goods

(5732) Radio and Television Stores
(5996) Camera and Photographic Supply Sotres
Hand Calculators

Consumption Goods

(5942) Book Stores
(5994) News Dealers and Newsstands
(7832) Motion Picture Theaters, Except Drive-in
(7833) Drive-in Motion Picture Theaters

SUPPORT FACILITIES FOR INFORMATIONAL ACTIVITIES

(15) Contract Construction of Office, School, Communications Buildings
(65) Rentals of Information Structures
(25) Furnishings for Office Buildings

Source: Porat, 1977

Numbers refer to SIC codes.

The contribution of the information sector to the economy has undoubtedly increased significantly in the past decade. There has been an explosive growth in the production and marketing of information goods and services as a result of advances in silicon chip technology which has increased the capacity and decreased the cost of information processors in office equipment, manufacturing equipment, home appliances, automobiles, etc., as well as resulting in a proliferation of consumer electronics equipment including video games, microcomputers, videocassette recorders, memory telephones, etc. Concommittantly, the FCC's "open skies" policy which has resulted in the proliferation of domestic satellite systems and the recent deregulation of the telecommunications industry have stimulated the growth of information-carrying telecommunications services. These technological advances and regulatory changes have in turn led to increased information activity in the secondary information sector.

In attempting to obtain a rough estimate of the growth of the information sector in recent years, one method is the application of Porat's model of the information economy to current census data. The model and the accuracy of census data allow some comparison over a period of years. The United States Census Bureau publishes data for individual industries classified by the Standard Industrial Classification (SIC) codes, which Porat also used in his model. For any industry, data are provided for the total number of businesses within the industry, the total amount of receipts, the number of employees within the industry, and the amount of the annual payroll.

Our application of Porat's model tracks the number of businesses within the industries that fall into the information sector definition.

An alternative approach might track the amount of total receipts for the information industries. This method, however, would tend to over-estimate the sector by duplicating revenues across several types of businesses. For example, when a bookstore makes a sale, a publishing company, a printer, a book binder, and a distributing company have each already recorded the sale of the product. A researcher might also choose to use the number of employees or the amount of the annual payroll to track the information economy. This method, however, would not produce comprehensive data since these figures are not disclosed in the census data for smaller industries and markets. Thus, this present research focuses upon applying Porat's model to the number of businesses within the industries of the information sector.

Table 2 shows the number of businesses in the United States business economy for three years: 1972, 1977, and 1980. During the period of 1972 to 1980, the percentage of businesses involved in the sector grew from 12.9% to 13.3%. Thus, the most recent (1980) census data show that over 600,000 businesses, whether they be small retailers or huge computer manufacturers, worked within the information sector. During this eight year period, the number of businesses grew 28.3%, while the information sector gained 31.6%. Table 4 breaks the classifications of the sector into sub-units, showing the performance of the functional areas of communication industries. Two subunits, "Search and Coordination Industries" and "Information Processing and Transmission Services," have experienced particularly high growth. Search and coordination industries include brokerage firms that often depend on large data banks and advertising businesses that use many of the new media. The growth in the information processing and transmission services subunit marks the effect of new cost-effective printing

Table 2: The Information Sector [illegible] 1972-1980

Indicators	1972		
Total Number of Businesses in the U.S. Economy	3,540,846	[illegible]	[illegible]
Total Number of Businesses in the Information Sector	458,086	585,866	[illegible]
Percentage of Businesses in the Information Sector	12.9%	13.5%	13.3%
Growth in Number of Businesses since 1972	--	22.9%	28.3%
Growth in Number of Information Sector Businesses since 1972	--	28.7%	31.6%

Source: <u>County Business Patterns</u>, Bureau of the Census

Table 3: The Information Sector in the Six-State Region: 1972-1980

Indicators	1972	1977	1980
Total Number of Businesses in the Regional Economy	405,002	515,604	552,889
Total Number of Businesses in the Information Sector	49,628	65,215	74,472
Percentage of Businesses in the Information Sector	12.2%	12.6%	13.5%
Growth in Number of Businesses since 1972	--	27.3%	36.5%
Growth in Number of Information Sector Businesses since 1972	--	36.2%	50.0%

Source: <u>County Business Patterns</u>, Bureau of the Census processes and of the increased use of electronic-based data processing. Although the subunit "Information Distribution and Communication Industries" seems to have lost many businesses over the period, this decline is due to the inclusion of educational institutions in the category. The demographics of the United States, discussed later in this paper, show that the decline in the number of schools coincides with the decline in the number of school age children.

[illegible]nal figures provide a basis for analyzing the information economy o[illegible] [illegible]ansas, Louisiana, Mississippi, New Mexico, Oklahoma, and Texas. [illegible] [illegible]at this six-state region contained a percentage of businesses in the inf[illegible] [illegible]tor that closely paralleled the nati[illegible]al percentage. In 1972 and [illegible] [illegible]ion's information sector was 12.2% and 12.6% of the total number of [illegible] respectively, slightly lagging the national figure. In 1980, however, the region's percentage of information businesses exceeded the national percentage at 13.5%. The growth of the sector within the region, 58.0% from 1972 until 1980, far exceeded the growth of the total number of businesses (36.5%). A grouping of the six-state region's information economy into subunits (Table 5) points out the area's particular strengths. In two categories, "Information Processing and Transmission," and "Wholesale and Retail Trade," show increases that exceed the national growth figure.

Although the census data for the information sector does allow a comparison of the six-state regional growth with the national pattern, the use of the single business unit masks much of the increasing predominance of information activities in the workplace. These data tend to underestimate growth in the communications sector since it can record

Table 4: Growth of Information Sector Subunits in the United States: 1972-1980

Information Sector Subunits	1972	1980	Percentage Change 1972-1980
I. Knowledge Production and Inventive Industries	167,252	223,468	+ 33.6%
II. Information Distribution and Communication	67,182	59,782	- 11.0%
Excluding Schools	35,282	43,264	+ 22.6%
III. Search and Coordination	140,384	201,542	+ 43.6%
IV. Information Processing and Transmission	40,171	58,204	+ 44.9%
V. Information Goods Manufacturing	19,439	23,699	+ 35.0%
VI. Wholesale and Retail Trade in Information Goods	23,658	33,115	+ 40.0%

Table 5: Growth of Information Sector Subunits in the Six-State Region: 1972-1980

[illegible]ledge Production and [illegible] Industries	17,700	27,649	+ 56.2%
II. Informat[illegible] and Communication	6,681	5,416	- 18.9%
Excluding Schools	[illegible]	3,818	+ 24.0%
III. Search and Coordination	17,[illegible]	[illegible]	+ 57.4%
IV. Information Processing and Transmission	4,082	[illegible]	[illegible]
V. Information Goods Manufacturing	1,521	2,364	+ 55.[illegible]
VI. Wholesale and Retail Trade in Information	2,196	4,017	+ 85.5%

Source: County Business Patterns, Bureau of the Census.

23

neither growth within an existing industry nor growth due to increased use of information technologies within traditionally non-informational industries.

This approach does not include the growth of business activity in the secondary information sector, where it appears that information is an increasingly important input. However, it is beyond our present capability to disaggregate the information activities in these businesses. The development of new quasi-information industries such as reservations systems operators, teleconferencing, information systems providers, and value-added telecommunications services is also likely to increase estimates of the size and contribution of the information sector.

B. What is Information Work?

We tend to think of information activities as components of the service sector, but the analysis above shows that information jobs are found not only in industries that produce information goods or services as a final product, but also in those that use information for the production of other goods. The research engineer, computer programmer, and secretary are obvious examples of information workers who require very different levels of education and skills. Writers, electronics technicians, and postal workers might also be considered information workers.

Information activities may be broken into the following classifications:

- *information creation*: e.g. writers, artists, scientists;
- *information organization*: e.g. editors, managers, librarians, archivists, curators;
- *information handling*: e.g. typists, data processors, filing clerks, telephone operators, postal workers;

information technology production : e.g. engineers, technicians, assemblers of computers, telecommunications, equipment, etc.

information technology distribution and maintenance: e.g. telephone and cable installers, electronics repair technicians, information equipment sales personnel.

Schement and Lievrouw have developed similar classifications which they are now using to identify information workers using the Dictionary of Occupational Titles. (Personal communication, 1983) What should be obvious is that information work encompasses a wide variety of jobs with a broad range of educational and skills requirements. While high technology industries are courted for their ability to create high technology jobs, it appears that few of these jobs will be in the more advanced information creation and information organization classifications.

C. Growth of Information Sector Occupations

Using Bureau of Labor Statistics based on moderate growth rates, Levin and Rumberger (1983) estimate that national employment will increase by 23% between 1978 and 1990, and find that of the five fastest growing occupations, three -- data processing machine mechanics, computer systems analysts, and computer operators -- deal with high technology products. Employment in the five highest growth occupations is projected to increase by over 100%, more than four times the employment growth rate in all occupations. (See Table 6)

However, as Levin and Rumberger point out, the total number of new jobs in these and other high technology occupations is relatively small, and will be vastly outweighed by employment growth in other areas. Of

Table 6: Employment and Employment Growth in the Fastest Growing Occupations: 1978-1990

Occupations	Employment (thousands) 1978	1990	Percentage Increase	Number of Jobs (thousands)	(percent of all occupations)
Fastest relative growth[a]					
1. Data pr[illegible]ssing machine mech	63	156	148%	93	0.4%
2. Paral[illegible]	28	66	132	38	0.2
3. Compute[illegible] s[illegible] ems analysts	185	384	108	199	0.9
4. Computer operators	169	317	88	148	0.7
5. Office machine and cash register servicers	49	89	81	40	0.2
Total	494	1012	105	518	2.4
Fastest absolute growth[b]					
1. Janitors	2585	3257	26	672	3.1
2. Nurses' aides and orderlies	1089	1683	55	594	2.7
3. Sales clerks	2771	3362	21	591	2.7
4. Cashiers	1501	2046	36	545	2.5
5. Waiters/Waitresses	1539	2071	35	532	2.4
Total	9485	12419	31	2934	13.3
Total, all occupations	97610	119590	23	21980	100 0

a. Based on the percentage increase in the number of jobs created

b. Based on the number of jobs created

Source: Levin and Rumberger, 19[illegible] the 20 occupations expected to generate the most jobs in the economy during this period, none is related to high technology. The five occupations expected to generate the most new jobs are all in low-skilled areas; janitors, nurses aides, sales clerks, cashiers, and waiters and waitresses. Only three or four of the "top 20" occupations in job growth require education beyond the secondary level, and only two require a college degree (teaching and nursing).

Revised BLS estimates show that high technology occupations as a group will account for only 7% of all new jobs between 1980 and 1990 (Coleman, 1982, quoted in Levin and Rumberger). Employment in all professional and managerial occupations is projected to increase by 28% between 1980 and 1990, compared to 45% during the previous decade. Clerical and service occupations are projected to account for 40% of the employment growth during this decade. Thus, employment growth for the economy as a whole will favor jobs that require little training beyond high school. (See Table 7)

As we have seen above, many workers throughout the economy will be expected to use information technologies in their jobs. While the use of these tools might be expected to result in more challenging work requiring more advanced skills, there is evidence that many jobs may become more routinized and repetitive. The assembly line division of work which became possible in the industrial sector through mechanization can now be extended to information occupations. In the newspaper industry, the skilled functions of typesetting and composition have been largely replaced by computer-aided phototypesetting and video display terminals. Multi-function secretaries can be replaced by an administrative assistant supervising a pool of word-processing typists whose productivity in terms of keystrokes can be electronically monitored.

Table 7: Employment Growth by Major Occupation Group: 1960-1990

Major Occupation Group	Employment Growth (percentage distribution) 1960-70 (1)	1970-80 (2)	1978-90 (3)
Professional and technical	30.0%	22.3%	20.3%
Managerial	6.0	22.7	7.7
Sales	5.8	2.6	7.0
Clerical	32.9	21.0	20.0
Crafts	11.2	9.5	12.2
Operatives	7.5	1.8	10.0
Laborers	.7	4.8	4.8
Farm workers	-14.5	-.2	-2.6
Service	20.4	15.5	20.7
Total	100.0%	100.0%	100.0%

Source: Levin and Rumberger, 1983

Organizations that represent office workers express concern about the issue of monitoring: "Automation is being used to increase control over employees and to create a situation of constant pressure for productivity. It has created the electronic equivalent of the moving assembly line," says the research director of 9 to 5 National Association of Working Women, an office workers' organization. (Andrew, 1983) Workers with computer-based automation tasks often complain that the new technology does not make the job more interesting. In a facility where workers process insurance claims, for example, all of the work is done at video display terminals (VDT's). These workers sit in front of a screen six hours per day, with one 15 minute break, typing material on claim forms into the computer. One worker describes the tedium of her task: "All you have to do ... is put a claim in front of you, punch some numbers, take another claim and punch some numbers. It's kind of an insult to anyone's intelligence." (Andrew, 1983)

One certain effect of new information technology is the decentralization of work. Some analysts estimate that as many as 50% of all office jobs could be done in an employee's home. These technological innovations coincide with changing conditions in the United States as many employees must couple professional responsibilities with responsibilities in the home. The prospect of working at home with flexible hours must certainly seem attractive to this portion of the labor force. However, only highly skilled and trusted workers such as researchers and programmers may be allowed to do challenging work at home. For others, such as clerical workers, the home has become the extension of the back office, where they may be paid on a piece work or parttime basis, without the employee benefits available to fulltime staff.

III. Changes in the Demography of the Six States

In order to predict the changes in the composition of the workforce in the six states and the demands on educational institutions, it is important to understand relevant demographic trends. This section will highlight demographic factors which educators must weigh in planning their responses to the demands of the growing information sector. More detailed demographic data analysis for the region is found in Cullen, Fredlund, and Sullivan, 1982.

Major demographic features of the region of importance in educational planning are summarized in Table 8. Between 1970 and 1980, the populations of each of the six states grew faster than the national population growth rate of 11%. The populations of New Mexico and Texas showed the greatest growth, with increases of 28% and 27% respectively. Arkansas' population grew 19%; Oklahoma's, 18%; Louisiana's, 16%; and Mississippi's, 14%.

While the nation as a whole is now overwhelmingly urban, two states in the region are still largely rural. In Mississippi and Arkansas, 53% and 48% of the population resided in rural areas in 1980. Texas was the most urbanized, with approximately 80% of its population living in urban areas. However, with the exception of Oklahoma and Texas, urban populations increased more rapidly than rural populations in the past decade, so that the majority of all citizens in the region will be living in urban areas by 1990. However, the region is likely to continue to have a higher percentage of rural residents than the nation as a whole. Although telecommunications may bring the benefits of the information technologies to these residents (through satellite reception of television, and telephone access to data banks, etc.), it will likely be

Table 8: Selected Demographic Characteristics of the Six-State Region

	U.S.	Ark	La	Miss	NMex	Okla	Texas
Percentage Change in Population 1970-1980							
Total	11.0%	18.9%	15.5%	13.7%	28.2%	18.2%	27.1%
Urban	11.6%	22.8%	20.0%	20.9%	32.6%	16.9%	27.0%
Rural	11.1%	15.0%	6.8%	7.9%	18.1%	20.9%	27.3%
Percentage of Black and Spanish Origin in Population (1980)							
Blacks	11.7%	16.3%	29.4%	35.2%	1.8%	6.8%	12.0%
Spanish Origin	6.4%	0.8%	2.4%	1.0%	36.6%	1.9%	21.0%
Median Income (1975)							
Total	$14,094	$10,106	$12,576	$ 9,999	$11,798	$12,172	$12,672
Whites	$14,664	$10,753	$14,825	$12,239	$12,356	$12,602	$13,299
Blacks	$ 9,045	$ 7,010	$ 6,823	$ 5,685	---	$ 7,636	$ 8,791
Spanish Origin	$ 9,948	---	---	---	$ 9,396	---	$ 9,363
Poverty Rate (1975)							
Persons	11.4%	18.5%	19.3%	26.1%	19.3%	13.8%	15.2%
Families	9.0%	14.1%	15.0%	20.4%	15.5%	11.1%	11.7%
Educational Achievement: Four Years High School or More (1976)							
Total	66.6%	56.2%	58.3%	52.3%	66.0%	65.6%	65.1%
Black	49.3%	33.7%	36.3%	27.4%	---	61.8%	53.9%
Spanish Origin	44.9%	---	---	---	47.7%	---	39.9%

difficult for them to find employment opportunities in the primary information sector.

One demographic characteristic common to the region is that each state contains substantial minority populations. Mississippi, Louisiana, Arkansas, and Texas all have large black populations. New Mexico and Texas have large populations of Hispanic origin. In addition, significant American Indian populations are found in New Mexico and Oklahoma.

Another common demographic characteristic is that many states in the region have experienced significant immigration from the northern United States and from Mexico. In New Mexico, for example, only 43.8% of the population have lived in the state all their lives, and fully 20% have lived in the state less than five years. In absolute numbers, Texas has the highest number of immigrants, primarily from Mexico.

Several characteristics of these minority populations are significant. First, they are likely to be poorer than the whites of the region, and poorer than their minority counterparts in the nation as a whole. All six states were below the national average in median income in 1975. While nationally the median income of blacks was only 62% of whites' income and the income of Hispanics only 68% of whites' income, in the six states the median incomes were lower both in absolute terms and in comparison with white incomes. In Mississippi and Louisiana, the states with the highest black populations, blacks earned only 46% of whites' income, or 37% and 25% respectively less than their black counterparts nationwide. In New Mexico and Texas, the states with the largest Hispanic populations, residents of Spanish origin earned as much as Spanish origin residents nationwide, but only 80% and 66% respectively of the income of white residents in their states.

All six states also ranked above the national average in their poverty rates for both incomes and families for 1975. Although these data are not broken down in Cullen et al. by race or ethnic origin, it is evident that the minorities accounted for a disproportionate number of individuals and families below the poverty line.

Similarly, in terms of educational achievement, the six states all ranked below the national average in educational achievement in 1976, although there has been continuing improvement. Blacks appear to be the farthest behind in educational attainment, with the percentage of blacks with four years of high school or more ranging from a high of 61.8% in Oklahoma to a low of only 27.4% in Mississippi. In three of the states, Arkansas, Louisiana, and Misissippi, only one in three or fewer blacks had completed at least four years of high school. Cullen et al. do not provide data on the growth rate of minority populations in the six state region. However, data from other regions indicate that the population growth rate of Hispanics in particular is higher than national growth rates.

The implications of these data for state employment planners and educators could be very significant. It appears that all of the states in the region are still "behind" in the educational qualifications of their residents, thereby limiting the job opportunities available to them. However, minorities are likely to be much more seriously affected. With lower educational levels and standards of living, blacks, Hispanics, and probably American Indians are all likely to lag behind their white counterparts in qualifying for skilled jo[illegible] the information sector. The fact that these are growing popula[illegible]s through both natural increase and migration indicates that the problems of unemployment and underemployment and economic disparities between racial and ethnic groups are likely to be magnified.

Table 9 shows the changes in school populations in the six states during the past decade. Although many states expect a decline in enrollment in the schools due to a decline in the school-age population, the six-state region will suffer less from this problem, since migration and natural increase will cause continued growth in the population. Table 9 tracks the school age population in each of the six states for the years 1970 and 1980. It is important to note that in each of the states, enrollment has increased for all age groups except 6 to 13 year category. Thus within a few years, the enrollment for the schools in the six-state region will again rise.

Table 9 shows the influence of ethnic and racial minorities on school enrollment. These enrollments parallel the demographic characteristics of the states. The presence of the minority population and the population of immigrants in the school system places many demands on the educator. The classroom is likely to contain children of diverse groups, each with specific needs. Fulfillment of these needs requires extra curriculum, more teacher training, and more money. These requirements are large orders for the public school system in a time when budgets in all levels of government are being reduced.

IV. Information Policy at the Federal and State Levels

A. The Federal Role in Information

There is no federal agency with a particular mandate for "information policy." In order to determine where information is considered in the federal system, we must consider information in a variety of contexts. For example,

Table 9: School Population Statistics in the Six State Region

	Total Students 1970	Total Students 1980	Percentage Increase/Decrease 1970-1980	Percent Black/Spanish Origin (1980)
Arkansas				
Age 0-5	194,169	210,527	+ 8.4%	24.5%
6-13	307,174	292,411	- 4.8%	22.2%
14-17	153,668	168,437	+ 9.6%	21.0%
18-22	158,550	203,269	+28.2%	17.0%
Louisiana				
0-5	426,363	428,676	+ 0.5%	38.5%
6-13	648,958	573,337	-11.7%	37.7%
14-17	312,436	328,455	+ 5.1%	38.0%
18-22	335,734	432,670	+28.9%	34.3%
Mississippi				
0-5	255,776	257,331	+ 0.6%	46.2%
6-13	393,086	356,820	- 9.2%	46.7%
14-17	194,906	200,046	+ 2.6%	44.2%
18-22	202,048	250,287	+23.9%	40.1%
New Mexico				
0-5	118,744	136,023	+14.6%	46.7%
6-13	196,103	178,813	- 8.9%	46.0%
14-17	91,369	103,070	+12.8%	45.8%
18-22	90,202	129,142	+43.1%	42.8%
Oklahoma				
0-5	239,333	278,318	+16.3%	12.1%
6-13	396,337	368,440	- 7.0%	11.1%
14-17	199,072	208,126	+ 4.6%	11.1%
18-22	224,768	291,508	+29.7%	11.4%
Texas				
0-5	1,218,659	1,393,082	+14.3%	43.9%
6-13	1,876,246	1,889,176	+ 0.7%	42.6%
14-17	904,931	1,023,848	+13.1%	38.4%
18-22	1,024,506	1,418,075	+38.4%	36.5%

transmission of information: broadcasting, telecommunications, the postal system

creation of information: science, research

dissemination of information: education, training, libraries

information technologies: science and technology

trade in information: international policy, trade and tariff policies

information as a product: copyright, patents, international trade

information and the consumer: access to information, consumer protection, etc.

From this classification it is apparent that numerous federal agencies have at least some role to play in information policy. However, for the purposes of this report, we will consider only major agencies involved in communications, education, and science and technology.

In some countries such as Canada and Australia, a federal Department of Communications is responsible for communications policy, including most information policy issues. In countries where the media or telecommunications are government operated, a Ministry of Information and/or Ministry of Posts and Telecommunications are generally responsible for communications policy. The United States has no federal department responsible for communications. Instead, responsibility is shared by several agencies. The principal agency concerned with information policy is the National Telecommunications and Information Administration (NTIA) within the Department of Commerce. NTIA was established during the Carter administration as a successor to the much more powerful Office of Telecommunications Policy (OTP) located in the White House under President Nixon. Although an important source of policy research in information and communications, and a funder of educational telecommunications (through its Public Facilities Program) and research (through its Boulder telecommunications research facilities), the influence of NTIA has been limited in both domestic and international policy formulation.

The focal point of domestic communication policy is the Federal Communications Commission (FCC), established under the Communications Act of 1934. The FCC's primary functions are the assignment of frequencies, the licensing of broadcasting stations, and the regulation of telecommunications carriers. Each of these activities can affect education. For example, the setting aside of FM radio frequencies and UHF television frequencies for public service and educational broadcasters ensured that demand by commercial broadcasters would not exclude noncommercial broadcasting. FCC policies on cable TV access channels have also guaranteed access to this medium by community and educational users. A current frequency allocation issue before the FCC concerned whether some frequencies assigned for Instructional Television Fixed Service (ITFS) should be reassigned to commercial operators of Multipoint Distribution Systems (MDS), a form of over-the-air pay TV. ITFS is used to transmit instructional programs to educational institutions, work sites, hospitals, etc. The FCC recently decided some of the unused educational frequencies may be used for MDS pay TV.

The FCC's current policy emphasis is on deregulation. The most visible example of the present deregulatory climate is the series of decisions which has led to competition in most parts of the telecommunications industry including foreign attachments, value-added services, and long distance communications. As a result of these decisions, users of microcomputers, for example, may connect their terminals to telephone

... data bases including such educational data bases as ERIC and ... data bases such as Compuserve and the Source.

The short term impact of deregulation ... in equipment and reduction in the cost of terminal ... charges. However, it may be that costs of local access will rise ... increases in monthly service charges and/or usage-sensitive local rates. In the latter case, "talking" to a computer across the city will no longer be free; the cost of communication will depend on the duration of the "chat."

Several federal agencies are responsible for research in information services, information technology, and education. Within the Department of Education (DOE), the National Institute of Education (NIE) has funded many pioneering projects and studies on the applications of educational technology, from educational television to microcomputers. A decade ago, the former Department of Health, Education, and Welfare (HEW) contained its own Office of Telecommunications Policy, which sponsored the Health, Education, and Telecommunications (HET) experiments on the ATS-6 satellite. Among the graduates of that experimental era which are now established services using commercial satellites are the Appalachian Community Services Network (ACSN) -- The Learning Channel, and the Learn/ALASKA teleconferencing and instructional broadcasting network.

Other research agencies include the National Science Foundation (NSF) which sponsors research in technology, applications, and policy, and the National Aeronautics and Space Administration (NASA) which made its series of Applied Technology Satellites and the joint U.S.-Canadian Communications Technology Satellite (CTS) available for educational and public service experiments.

In the legislative branch, the Congress addresses information issues through a number of committees. Communications matters are covered by the House Subcommittee on Telecommunications, Consumer Protection, and Finance and the Senate Subcommittee on Communications. Science and technology issues and their relationship to education are addressed in the House and Senate Science and Technology Subcommittees. Education is also covered by the Senate Subcommittee on Labor and Human Resources. International information and communications policies are also addressed [illegible] House and Senate Subcommittees on International Operations. [illegible] are prepared at the request of Congress by the Office of Technology [illegible] (OTA) and the Congressional Research Service (CRS).

The Congress has been particularly [illegible] ing legislation that addresses educational needs. In the past year, leg[illegible] proposed several bills to better prepare students and educators for [illegible] in the information age. Both the House and the Senate proposed legislation for funding of teacher training in high technology and science and math (H.R. 2332, S. 1091). H. R. 1310 takes this objective one step further, seeking to "provide a national policy for engineering, technical, and scientific personnel; to provide cost sharing by the private sector in training such personnel." H.R. 2143 would amend the Education Consolidation Act of 1981 by granting funds for mathematics and reading competencies to high schools in economically depressed areas. Other grants for research and instruction in math and science were proposed in S. 1093 (research) and S. 1055 (instruction). Finally, one House proposal (H.R. 2417) would give tax credits to corporations that donate computer equipment to schools.

These are but a few of the many agencies that address issues in information policy. A list of key federal and congressional agencies with responsibilities for various aspects of information policy is given in Table 10.

B. State and Local Agencies

On the individual state level, it is difficult to find agencies that deal with information policy *per se*. Many states do have a public utility commission that oversees telephone rate structures among its many functions. The states also have a department responsible for education, a key component of the information sector. However, many regulatory functions that address information policy are left to municipal government. Cable television franchising policies, for example, are made in city governments.

Other activities concerning information are buried in state bureaucracies, often according to the technical needs of individual state offices. In Texas, for example, state government telecommunications are the responsibility of the State Purchasing and General Services Commission. However, there is no state unit responsible for information or communication policy.

Despite the lack of state information policies, state officials do express concern about the growth of the information sector in their states. This concern is often manifested within the state economic development offices. Generally, development staff regard information technology as a portion of the "high tech" group of industries. The development offices in each of the six states list "high tech" businesses as top priorities in terms of the industries their offices need to recruit for location within the state. All six states have further fostered this type of growth by creating "high tech task forces." These

Table 10 : Major Federal and Congressional Entities Concerned with Information Policy

Transmission of Information:

Federal Communications Commission (FCC)

National Telecommunications and Information Administration (NTIA)

U.S. Postal Service (USPS)

Communications Satellite Corporation (COMSAT)

Corporation for Public Broadcasting (CPB)

Rural Electrification Administration (REA) (Rural Telephone Bank)

House Committee on Energy and Commerce: Subcommittee on Telecommunications, Consumer Protection and Finance

Senate Committee on Commerce, Science and Transportation: Subcommittee on Communications

Science, Research and Technology

National Institute of Education (NIE)

National Science Foundation (NSF)

National Aeronautics and Space Administration (NASA)

Office of Technology Assessment (OTA)

Congressional Research Service (CRS)

House Science and Technology Committee: Subcommittee on Science, Research and Technology

Senate Committee on Commerce, Science and Transportation: Subcommittee on Science, Technology and Space

Dissemination of Information; Education; Training

Department of Education (DOE)

Department of Labor

Library of Congress

U.S. Government Printing Office (GPO)

National Technical Information Service (NTIS)

House Committee on Education and Labor

Senate Committee on Labor and Human Resources

Information and the Consumer

Department of Justice (DOJ)

Federal Trade Commission (FTC)

House Committee on Energy and Commerce: Subcommittee on Telecommmunications, Consumer Protection and Finance

Senate Committee on Commerce, Science and Transportation: Consumer Subcommittee

42

Table 10 continued:

International Information Policy and International Trade

Department of State

Department of Commerce

Export-Import Bank

House Committee on International Affairs: Subcommittee on International Operations

Senate Committee on Foreign Relations: Subcommittee on International Operations ad hoc task forces, appointed by the governor or the state legislature, aid development offices in recruiting new firms to the state.

Some state legislatures have taken their priority one step further by introducing legislation that would create economic incentives for "high tech" firms in their states. Of the six states, Mississippi was the first to pass such a bill during its 1983 legislative session. This legislation (House Bill 711) authorizes the economic development board to create "high tech" zones, where businesses could obtain sales tax exemptions, tax credits, and other financial incentives.

On the municipal level, city officials are beginning to address the same goals. San Antonio, Texas, has approached the objective of recruiting "high tech" firms in a unique manner. An agency funded by the city's existing private sector, the Economic Development Foundation, has taken on duties similar to the states' economic development office. This foundation maintains a computer data base that identifies high growth industries that may be attracted to San Antonio. In addition, several personal computers help in the production of 200 to 400 letters mailed weekly to prospective companies. The foundation also spends a portion of its budget on advertising the city in business magazines such as Electronic Business. This foundation waged a successful campaign to recruit information sector businesses in 1983. Advanced Micro Devices, a micro processor firm, and Spraque Electric, a maker of capacitors, have decided to locate in San Antonio.

The positive economic climate of the six-state region has captured many information industries in the past few decades. Western Electric, the equipment manufacturing branch of the Bell system, located a plant in Shreveport, Louisiana, in 1965. This production facility has grown over the years, and now employs approximately 5,000 workers. The development office of Arkansas reports that the state is gaining a reputation as a favorable location for biotechnical research and computer software. Systematics Corporation, an interstate banking service, has also recently located in the state. Several information industries have prospered in Texas' business climate, notably Texas Instruments, Tandy Corporation, and Harte Hanks Communications, a company that operates several types of media in all parts of the United States.

The intensity of these state and city efforts to attract information-based industries is best illustrated in the recent campaign staged by Austin and the state of Texas to attract the Microelectronics and Computer Technology Corporation (MCC). Prominent business and government leaders helped devise a recruitment package that included the donation of land for a permanent office space, the commitment of $15 million in fellowships and teaching positions and other resources by the University of Texas, special relocation services and subsidized loans for MCC employees, and various other benefits.

V. Educational Policy Issues

A. What Knowledge and Skills Will Students Need?

The above sections have presented an overview of the growth of the information sector in the U.S. economy and the six state region, relevant economic and demographic characteristics of the region, and information policy making entities at the national, state, and local level. This part of the report relates these topics to policy issues facing educators.

While it is evident that information technology will be increasingly common in the workplace and the home, the implications for education of tomorrow's adults are unclear. The development of information technology has changed the types of skills needed to live and work in the new era. Thus recent studies have recommended general curriculum changes for the public schools. A Nation At Risk, the report of the Commission for Excellence in Education (1983) recommended that schools strengthen their programs in mathematics and science. In addition, it proposed that high schools begin more computer instruction, equipping graduates to: "(a) Understand the computer as an information, computation, communication device; (b) use the computer in the study of the other basics and for personal and work-related purposes; and (c) understand the world of computers, electronics, and related technologies."

Clearly, the more highly skilled jobs in the information sector will require a strong foundation in these subjects. But as we saw at the beginning of this report, these jobs will account for a relatively small proportion of the new employment created in this decade. Most of the new jobs will be in the less skilled and lower paying occupations, and some existing clerical jobs may require less skill, as machines become more intelligent and tasks more repetitive. Does this mean that educators do not need to worry about the knowledge and skills students need to acquire to function in an information-based society? We think not. First, it is evident that many more jobs will require some use or familiarity with information technology. Second, while some tasks may become less challenging, many jobs will require greater conceptual and analytical skills, as the routine steps will be done by the technology. Finally, social and economic changes are resulting in a more complex society in which students will need both knowledge and analytical skills to act as informed citizens and consumers.

Thus we believe that educators should stress not only the skills students will need to use information technologies and hands-on experience with these technologies, but also a rigorous "traditional" education which provides the knowledge and reasoning skills students will need to function in an increasingly complex society.

B. Applications of Information Technology for Education

This section presents examples of how information technologies can be applied in education. We tend to think of use of these technologies in the classroom, for example, to enable students to become "computer literate." While classroom experience is important, instructional technologies can be used for a variety of purposes including classroom curriculum, instructional methods, teacher training, and educational administration.

Although it would be impossible to provide a complete listing of these new instructional tools, a few examples illustrate the diversity of available resources and applications.

Teleconferencing to Reach Educators:

With their capability to link groups separated by distances and time, new communication technology offer great opportunities in the improvement of school administration and information-sharing. Although the school systems around the United States vary in size and demographics, many administators face common objectives and problems. One cooperative program, Project Best, uses information technology to address the subject of applying the new technology to basic skills education. DOE's Division of Educational Technology funds Project Best, with Educational Communications and Technology the primary contractor. The purpose of the project is to "provide training and technical assistance to state education agencies in the area of applying the new information technology to their particular state efforts in basic skills instruction." So far, Project Best has developed a variety of information services including: written material, audio and video teleconferences that detail successful use of technology, an electronic information exchange service, a data bank that includes an outline of available software and local experts in information technology, a telephone "hotline" that addresses specific district needs. Since October 1982, Project Best has offered four video satellite conferences exploring such topics as: organizing for new technology on a state level, getting started with technology, computer literacy, and software/hardware evaluation. To date, 41 state education agencies are participating in Project Best. Texas is the only participant in this six-state region. (Ingle, 1983)

Videotext and Teletext:

Videotext is an interactive information technology in which the user requests information through a telephone or interactive cable link with computer data banks. This information is delivered to a specially-equipped television set. In contrast, teletext is not interactive; information is broadcast and received on the television set, employing an unused portion of the broadcast television signal (the vertical blanking interval). Designed primarily to provide access to agriculture information, Project Green Thumb (described above) provided information and instruction to children as well as their parents in rural Kentucky. Two-thirds of the families participating in the project had children in the home. Research showed that these children made extensive use of the system (Chen and Paisley, 1983). They accessed both the 4-H portion of the menu, which included games aimed at career exploration, and the "adult" portions of data base, including weather maps, forecasts, and farming information. Chen and Paisley report that in some households, the responsibility for retrieving information from the Green Thumb system was delegated to children.

Because teletext currently uses limited bandwidth by sharing with a broadcast television channel, the amount of information is limited -- often only 300 frames, or pages, are available at any given time. Chen and Paisley suggest that this capsulized information is particularly attractive to children. In Los Angeles, the PBS station KCET now offers a teletext service that includes children's programming. Popsicle, broadcast in after-school hours, features activities and quizzes for children. Think Shop is a program designed for viewing within the school curriculum. This program teaches cur[illegible]nt events and addresses special topics such as handicap awareness and space exploration, requested by local teachers. Think Shop also works to reinforce other instructional programs. After viewing other KCET instructional television programs, students work on exercises provided by Think Shop.

Teachers and librarians using KCET's teletext programming say that "children are motivated to read the teletext screen. The emphasis on oral reading and discussion of the teletext vocabulary may also help Hispanic students who are learning English as a second language." (Chen and Paisley, 1983)

Video Technologies

Instructional television was the first information technology to gain federal support through the then Department of Health, Education, and Welfare (HEW) in the early 1960's. Beginning with the Educational Broadcast Facilities Program, a project designed to improve the country's public television capabilities, federal programs thrived in the 1960's, enjoying successes such as the Children's Television Workshop (creative body for "Sesame Street" and "The Electric Company"). The Office of Technology Assessment notes that such support "has fallen precipitously from a temporary short-term peak." (OTA, 1982) Although programs like "Sesame Street" no longer receive public funding, the Department of Education did provide one new grant of $2.9 million in 1982, bringing the total funding for educational television to $21,411,000 for 1982. It is not clear, however, what proportion of those funds will be used for elementary and secondary school projects, in contrast to those for higher education.

The technological capability for interactive cable systems may offer additional educational opportunities. The Warner Cable Company introduced the first system with interactive, or two-way capability in Columbus, Ohio in 1977. In addition to sports, movies, and a children's channel, the Warner system, QUBE, allows viewers to register opinions about questions posed during special programs. Research indicates that families used these response capabilities three or four times per day. In addition, a videotext system was introduced to QUBE recently. Early anecdotal research shows that children used this system, particularly the electronic mail service. (OTA, 1982)

Video cassettes and particularly video discs possess interactive capabilities that could be used for education. With a video disc system connected to a microcomputer, thousands of images may be stored and retrieved virtually instantaneously. Thus specialists can create instructional programs that allow a child to stop at any individual frame or to view certain sequences in real time, just like a film. With the aid of a computer, a video disc system can be used for a sophisticated educational program, complete with bridging sequences and slow-motion demonstrations. This new technology offers many choices to the creator of the program -- so many, in fact, that developing the skills needed to complete such programs is difficult and costly. Funding for such development is scarce. Although the Department of Education budgeted $975,000 toward the development of video disks in 1982, one report indicates that this program may be abandoned due to general lack of funding (OTA, 1982).

Microcomputers

As Chen and Paisley (1983) indicate, "in the future, children will probably encounter more electronic text and graphics on the screens of microcomputers than on the screens of videotext, teletext, or interactive cable systems." By 1983, five million microcomputers had been sold in the United States, with approximately 145,000 of those in the schools. (OTA, 1982)

Although the number of computers in the schools has more than doubled since mid-1980 (Chen and Paisley, 1983), there are problems that block wide-spread use of the technology as an instructional tool. First, the computer/student ratio is not adequate to support frequent instruction using the computer. Second, many educators complain that the software or educational programming available to microcomputer instruction is far from adequate. The first programs created for the educational market tended to be mathematics-oriented and relied heavily on drilling exercises (Schorr, 1983), becoming more "electronic workbooks" than unique instructional tools.

Although high development costs and uncertain market conditions have slowed the development of new software, a new generation of programs and languages has recently been produced. This software, sometimes called "discovery" software uses games and simulations to relay educational content. Many of these innovations are available in locations other than school and home. For example, the Capital Children's Museum in Washington, D.C. and three theme parks called "Sesame Place" (developed by the Children's Television Workshop) have developed software using formative research techniques. Many of these educational games are now being prepared for the educational market (Chen and Paisley, 1983).

B. Coping With Shortages of Teachers and Funding

With all the new opportunities for using information technology as an instructional tool and the new mandates for more training in computer science and related areas, many teachers are faced with the same "technological illiteracy" as their students. Even highly motivated teachers may be hard-pressed to seek additional training in information technology, given the demands of their jobs and the low average salary earned in most school districts. (After 12 years experience, the average salary of United States teachers is $17,000) (National Council, 1983) In addition, the growing commercial demand for those with scientific and technical skills has enticed mathematics and science teachers to desert teaching for industry, and has diverted other would-be teachers. In 1981, one survey indicated that of 45 states, 43 had shortages of mathematics teachers, 33 had a shortage of earth-science teachers, and all 45 did not have enough physics teachers. (National Council, 1983)

Many school systems have developed new programs designed to meet their requirements for teachers with technological knowledge. The Houston school system, for example, created a new position for these teachers, called "teacher technologist." These people will "teach teachers, parents, and youngsters and serve as catalysts, planners, and implementers of computer literacy and other programs on individual school campuses." These new positions carry pay incentives above the standard teachers salary, (OTA, 1982) although some labor leaders object to the practice.

Other schools look to the business community for support in the training function. "Adopt-A-School" programs around the country have recruited corporate expertise for the classroom. Says one school administrator, "In a highly technological society, where technology is changing rapidly and the costs are increasing, our training potential decreases. We can't invest in the new equipment, so some linkage between businesses and education has to occur, or we'll be training people for jobs that aren't there." (Churchman, 1983) The Dallas school system spends $250,000 each year to attract aid from business, holding "tea and luncheon talks" for prospective adoptors. (Churchman, 1983)

The demands on education imposed by the new information era are significant. Thus it is no surprise that they are also costly. Funding for new information technology and instruction must compete with other crucial budget items in an era of tightening federal, state, and local budgets. In addition, since many of the technologies are new, educators may find it difficult to estimate exactly how much given programs may cost since implementation may contain many hidden costs such as obsolesence, training, and plant overhead.

Federal funding for these programs has diminished, although several agencies still support the development of instructional applications of information technology. Table 11 shows the 1982 funding of these programs listed by the type of technology. Local systems, however, must still cover the bulk of costs for the procurement and implementation of new technology programs. Again, many schools have turned to the business community for some of the funding. Many businesses have been persuaded

Table 11: Federal Research and Development Funding for Educational Technology by Type of Technology, for Fiscal Year 1982

Technology	Agencies Funding	Funding Level (in millions)
Computer-based Instruction	NSF; DOE; DOD	$ 5.55 (est)
Educational Television	DOE	21.411
Teleconferencing	DOE	1.1 (est)
Video Disc	DOE	0.975 (est)
Electronic Mail	DOE	0.3 (est)
Satellite	DOE (funding of Regional Laboratories)	0.05 (est)
Calculators	DOE	0.3 (est)
Other		4.55 (est)
	TOTAL	$ 34.236 (est)

Source: Office of Technology Assessment, 1982 to donate new or used information equipment to schools. In addition, information technology corporations such as Apple, Atari, and Tandy have created non-profit organizations aimed at encouraging the use of technology in education. (OTA, 1982)

C. Matching Technologies and Needs

Educators are just beginning to address several other issues raised by new technologies. Educators must establish policy guidelines for the selection and implementation of equipment and curriculum. They must work to match the needs of their students with the appropriate technology. And finally, they must address the question of the equitable distribution of this new technology.

Because most information technology has recently been introduced to school systems, the guidelines for its selection do not make up any comprehensive policy. Other instructional materials such as textbooks, are subject to strict selection processes. For example, funding for textbooks for the public schools is provided by state governments. Thus, textbook adoption policies are usually set at this level. Since Texas' policy has drawn a considerable amount of publicity, it can serve as an example of the adoption process. The adoption process for textbooks to be used in Fall, 1984, began in March of 1983 when the Board of Education selected an adoption committee. This committee will review publishers' petitions, hold public hearings, and review the texts according to strict content criteria. The committee's adoption list will be submitted to the Board of Education and approved in November of 1983.

In contrast, the policy governing the selection of educational hardware and software is as varied as the school district themselves. Local district decision makers may be ill-prepared to make decisions about instructional materials involving computers or instructional television. At the same time, the producers of these materials may be ill-prepared to fund marketing efforts adequate to serve so many small-volume clients.

While an abundance of incompatible technology may be creating headaches for educators, lack of adequate educational software may be equally frustrating. The difference is a question of incentives. While there is an obvious incentive to sell as many microcomputers as possible to the schools, the ease of duplication of software has discouraged software developers. Vendors are urged to supply floppy discs that are not "copy-locked" so that a working copy can be made from an undamaged original disc. However, the temptation is to make multiple copies of the disc to reduce software costs. Similarly, it is now easy to share computer programs by transmitting them over telephone lines. Just as the advent of videocassettes has raised copyright issues in the broadcasting industry, the ease of computer software duplication may require negotiation between educators and software providers to ensure an adequate supply of affordable and appropriate programs.

In addressing these new educational needs in information technology, educators must also work carefully to match the needs of their students and their schools with the appropriate technology configuration. The history of applications of educational technology is full of examples of programs in which poor planning jeopordized the effectiveness of the project. For example, in the early 1960's, The Midwest Program of Airborne television was a project in which an airplane circled over Purdue, Indiana, broadcasting television lessons to a large midwest area. While an innovative means of distributing educational programs, the project was a failure. Some of the programs did not fit school schedules, and administrators refused to change the schedules to accommodate the new programs. In addition, in many rural schools where the programs might have proved the most beneficial, the classrooms were not equipped with television sets. (Council on Learning, 1980)

While most schools now have television sets and videotape recorders, the same type of problems may recur with microcomputers.

Recently, one school district in the Southwest planned for a $2.5 million computer program, providing each elementary and junior high school with a single computer. Advisors noted that this plan would allow each student only two hours of computer time per year. One advisor told local officials that "they'd be better off using the money to buy the kids crayons." (Schorr, 1983).

D. Issues of Equity

One major problem with the introduction of new information technology into the schools is the question of equity. An example from the Atlanta school system dramatizes this issue. A high school in one of the wealthy suburbs now has 18 microcomputers, most of them donated by parents. A school in a poor, inner-city neighborhood has only six. Says the dean of Harvard's School of Education: "We have a system of education in this country that is highly inequitable. There is a tremendous diversity between school districts and among the states. Computers are a small exacerbation of a more fundamental problem." One 1982 study showed that 72.6% of the country's rich high schools had some instructional computers, while only 45.5% of the poorest high schools possessed them (Loeb, 1983).

This problem may be more pronounced in the schools of the six-state region. As the earlier discussion of demography of the school systems shows, these systems are characterized by diverse student bodies, with attainment levels for minorities lagging behind the levels of other students. In addition, these states have substantial rural populations, where schools may also have trouble keeping up with urban schools funded by larger tax bases.

Any comprehensive plan for the introduction of new technology must carefully analyze this issue since by its nature, information technology is capable of narrowing, rather than widening the "information gap." Schools are charged with responsibility in particular because of the large influence of home life, where those with higher socioeconomic status are most likely to gain exposure to new media.

The equity issue may be doubly important because the school may be called upon to redress inequitable access to information technology in the home. While consumer information technologies including cable television, video games and microcomputers are proliferating, use of information technology in the home usually varies with the income level of the family (Chen and Paisley, 1983). Thus inequitable access to information technology in the home may leave the schools with the task of closing the "information gap."

Even where technologies are available, schools may need to pay particular attention to teaching the basic literacy, numeracy, and reasoning skills that will enable students to use the technology productively. This strategy is likely to be particularly important in the six-state region because of its minority and rural populations. Minorities comprise more than 35% of the population in four of the six states (Louisiana, Mississippi, Oklahoma, and Texas). Educational attainment of minorities is already significantly lower than that of whites. Minority students will need particular attention if they are to have an opportunity to qualify for the limited number of highly skilled jobs. Without adequate education and skills, they will be qualified only for the pool of low income jobs. In the long run, their lack of skills will only exacerbate the already large income gap between whites and minorities in the region, and even between minorities in the region and their counterparts throughout the country.

VI. Conclusions

This report has attempted to relate the changes in the economy and society as a result of the impact of information technology to issues facing educators, with particular emphasis on trends in the states of Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma, and Texas. We have seen that the shift toward an information-based economy is reflected in the economies of the six states. Thus, there are likely to be new career opportunities for students in employment involving information and information technology. Similarly, "traditional" occupations are likely to require more familiarity with these technologies.

While these are optimistic if challenging prospects, other less promising factors should also be considered. First, the largest growth in employment is likely to be in the least skilled and poorest paying occupations. The highly skilled high technology jobs will increase dramatically in percentage terms, but will result in a relatively small number of new jobs. Second, demographic conditions in the six states are likely to make the educators' task even more demanding. In four of these states more than 35% of the school age students are minorities, either black or Hispanic. Minorities already rank considerably below whites in educational attainment. Third, personal income levels of these states are below the national average, with minorities significantly lower in income than whites and than other minorities throughout the country.

Thus educators will have to face many challenges in preparing for an information-based society. They will need to strengthen the traditional curricula to ensure that all students gain the knowledge and basic skills they will need to function in a more complex society. They will need to provide an opportunity to learn new skills such as computer programming and to strengthen related subjects, particularly in mathematics and science. The schools will be important not only as sources of learning but as means of closing the "information gap" between students with access to information technologies in the home and the ability to use them, and disadvantaged students whose families cannot afford these new tools or who do not have the skills or incentive to use them for educational purposes.

These challenges confront the schools in an era of fiscal restraint at all levels of government. The shortage of funds and of specialized personnel will force the schools to look for innovative ways of acquiring the facilities and talent they need. Partnership with industry, establishment of special programs in technical and business subjects, and creation of incentives to attract professionals to the teaching profession are all strategies that have been successfully demonstrated in the region.

The new technologies themselves are promising tools for educators. Yet simply purchasing the hardware may accomplish little. Educators must ensure that there is adequate opportunity for all students to use the technologies, and that the software provided is appropriate and stimulating for the students. Otherwise, we may simply repeat some of the failures of educational technologies over the past 25 years. Yet the growth of the information sector offers great opportunities for educators — to develop creativity, to teach more effectively, and to enable students to participate in lifelong learning. This region, which has already established itself as a leader in developing and attracting information-based industries, can also become a leader in educating its citizens for an information-based society.

References

Andrew, John, "As Computers Change the Nature of Work, Some Jobs Lose Savor." Wall Street Journal, May 6, 1983, p. 1.

Bell, Daniel, "The Social Framework of the Information Society." In The Microelectronics Revolution, Tom Forester, ed. Cambridge, MA: MIT Press, 1981.

Bell, Daniel, The Coming of Post-Industrial Society. New York: Basic Books, 1973.

Chen, Milton, and Willaim Paisley, "Children and the New Computer Technologies: Research Implications of the Second Electronic Era," Stanford: Stanford University Institute for Communication Research, 1983.

Churchman, Deborah, "Foster Parent for the Schools: Business." New York Times, May 5, 1983, Section 12, pp. 58-59.

Compaine, Benjamin M. "The New Literacy." Daedalus. Winter 1983, pp. 129-142.

Coleman, Garrett V. 1982. Memorandum compiled from revised BLS employment estimates, 1980-1990, in Levin and Rumberger, 1983.

Council on Learning. The Communications Revolution and the Education of Americans. New Rochelle, New York: Change Magazine Press, 1980

Cullen, R., Fredlund, E. and Teresa A. Sullivan. "Population Statistics for Educational Needs in the Six-State Region: A Descriptive Analysis," Austin: Southwest Educational Development Laboratory, 1982.

Dizard, Wilson P., Jr. The Coming Information Age. New York: Longman, 1982.

"Drilling Supervisory System For Oil Field Communication Improves On-Site Supervision." Communication News, January 1982, p. 84.

"FCC Gives Pay TV Right to Bid for Use of 8 School Channels." Wall Street Journal, May 27, 1983, p. 44.

Fiske, Edward B., "New Priority: Technological Literacy." New York Times, April 24, 1983a, Section 12, p. 1.

Fiske, Edward B., "Study Asserts Quality of Schools Presents Economic Threat to U.S." New York Times, May 5, 1983b, p. 1.

Foster, Rick. "Computers in Agriculture." Agriculture Education Magazine, January 1982, pp. 5-6.

Harkness, R.C. Technology Assessment of Telecommunications/ Transportation Interactions. Menlo Park, CA: SRI International, May, 1977. In Margrethe H. Olson and Roberta Tasley, "Telecommunications and the Changing Definition of the Workplace." Paper presented at the Annapolis Telecommunications Policy Research Conference, April 1983.

Ingle, Henry T. "Project BEST: What Is It? ... Who's Involved? ...And How Are States Benefitting?" Monitor, March/April 1983, pp. 31-34.

Ladendorf, Kirk. "Executives Back Incentives to Help Lure Computer Firm." Austin-American Statesman, May 18, 1983, p. 11A.

Levin, Henry M., and Russell W. Rumberger. "The Educational Implications of High Technology." Stanford: Stanford University, Department of Education, February, 1983.

Loeb, Margaret. "Computers May Widen Gap In School Quality Between Rich and Poor." Wall Street Journal, May 26, 1983, p. 1.

National Commission on Excellence in Education. "A Nation At Risk: The Imperative for Educational Reform." Education Week. April 27, 1983, 12-16.

"1983 Marketing Strategy," San Antonio Economic Development Foundation, 1983. Unpublished document.

Office of Technology Assessment. Information Technology and Its Impact on American Education Washington: U.S. Government Printing Office, 1982.

Padilla, Maria. "Home Banking Tests Begin in a Few States." Wall Street Journal, January 17, 1983, p. 25.

Porat, Marc. The Information Economy: Definition and Measurement. Washington: U.S. Government Printing Office, 1977.

Schement, Jorge Reina, Leah A. Lievrouw, and Herbert S. Dordick, "Social Factors Influencing the Emergence of an Information-Oriented Society in California." Telecommunications Policy, Spring, 1983.

Schorr, Burt. "Many Schools Buying Computers Find Problems With Using Them." Wall Street Journal, April 7, 1983, p. 29.

U.S. Bureau of the Census, County Business Patterns. Washington: U.S. Government Printing Office, 1972, 1977, 1980.

van der Velde, Marjolijn, "Home Banking." The Magazine of Bank Administration, September 1982, p. 12.

Warner, Paul D., and Frank Clearfield. An Evaluation of a Computer-Based Videotext Information Delivery System For Farmers: The Green Thumb Project. Lexington, Kentucky: University of Kentucky, 1982.

Proposed Legislation Cited

H.R. 1310, 98th Congress. "An Act to provide assistance to improve elementary, secondary, and post-secondary education in mathematics and science; to provide a national policy for engineering, technical and scientific personnel." March 7, 1983.

H.R. 2143, 98th Congress. "A Bill to amend the Education Consolidation and Improvement Act of 1981 to provide grants for secondary schools to improve mathematics and reading competencies. March 16, 1983.

H.R. 2332, 98th Congress. "A Bill to amend the Vocational Education Act of 1963 to make grants to the states for high technology vocational programs." March 24, 1983.

H.R. 2417, 98th Congress. "A Bill to amend the Internal Revenue Code of 1954 to encourage the training of elementary and secondary school teachers in the use of computers and to foster contribution of computer equipment to elementary and secondary schools." April 5, 1983.

S. 1055, 98th Congress. "A Bill to provide a block grant for improvement of instruction in the fields of mathematics and science." April 14, 1983.

S. 1091, 98th Congress. "Mathematics and Science Education Act of 1983." April 19, 1983.

S. 1093, 98th Congress. "A Bill to provide for research on and evaluation and assessment of education in mathematics and science." April 19, 1983.

House Bill No. 171, Mississippi Legislature. "Mississippi High Technology Zone Act of 1983."

Persons Contacted

Wendell Adams, Research Director
Arkansas Industrial Development Commission
One Capital Mall
Little Rock, AR 72201

Greg Burcell
Louisiana Board of Commerce and Industry
Department of Commerce
P.O. Box 44185
Baton Rouge, LA 70804

Jim Miller, Director
Division of Industrial Development
Department of Economic Development
P.O. Box 849
Jackson, MS 39205

Project BEST
Association for Educatic [illegible]l Communication and Technol[illegible]
1126 16th Street NW
Washington, D.C. 20036

San Antonio Development Foundation
602 E. Commerce Street
San Antonio, TX 78296

SOUTHWEST
EDUCATIONAL DEVELOPMENT LABORATORY
211 EAST 7th STREET
AUSTIN, TEXAS 78701
512/476-6861